admission of fresh air in the piston the fresh cool air, owing to its greater specific gravity, remains at the bottom of the cylinder immediately over the piston, while the hot gaseous products of combustion remain in the upper portion of the cylinder and in the combustion-chamber and are first to be discharged on opening the exhaust-valve. A further advantage is gained by arranging the air-inlet valve in the piston, as it opens readily inwardly during the non-firing downward stroke of the piston and offers little resistance to the latter, thereby supplying a sufficient quantity of fresh air with the least expenditure of power. The automatic air-valve also opens when there is a partial vacuum in the combustion-chamber, so as to relieve the piston from any back-pressure due to a light charge of sprayed oil. The central arrangement of the exhaust-valve affords a free escape for the products of combustion, which is important, as an admixture of the same with the air would materially impair the energy of the engine by reason of an imperfect combustion. Any leakage of gases through and around the piston escapes into the base of the engine, and a decided advantage is gained in ventilation by drawing the fresh-air supply for the combustion-chamber from the base of the engine, thereby avoiding any unpleasant odors resulting from leakage. By constructing the incandescent burner of platinum and asbestus or other substance capable of being highly heated it will wear a long time without injury from the inflammable charges.

The products of combustion generated by the burner are very small in volume, so that they have no appreciable effect upon the force of the expanding charges, and as no ignition can take place until the charge of atomized oil enters the combustion-chamber, there is no necessity for withdrawing the burner from the combustion-chamber after ignition, as is usual in explosive-gas engines, and thus much complication is avoided.

In the modified construction of the spray-nozzle represented in Figs. 15 and 16 the nozzle is composed of a steel cylinder q, provided with radial perforations, and secured to the lower end of the hollow depending stem e^7. The interior of the cylinder is lined with finely-perforated sheet metal r. The perforations in the outer cylinder are comparatively large, while those of the lining are very fine and divide the oil more minutely as it is forced through the same by the blast of air. By this means the finely-perforated sheet metal is protected from the combustion in the combustion-chamber by the enveloping thick-steel cylinder, while the latter serves as a firm support for the sheet metal. This spray-nozzle delivers the oil radially into the combustion-chamber all around the nozzle in jets of very fine spray. Each of the large openings in the enveloping cylinder emits a separate jet composed of numerous fine jets, and, the several jets being separated by air-spaces, a very effective combustion is obtained.

I do not wish to claim anything in this application which is claimed in my pending application, Serial No. 333,846, filed December 14, 1889.

I claim as my invention—

1. The combination, with the engine-cylinder, its piston, and an air-inlet through which air is admitted to the cylinder, of an oil-receiving chamber having an outlet into the engine-cylinder, a conduit through which compressed air is admitted to said chamber, a conduit through which oil is admitted to said chamber, and a discharge-valve applied to said chamber, whereby the charge of oil is blown out of said chamber and delivered into the cylinder by the compressed air upon opening the valve, substantially as set forth.

2. The combination, with the engine-cylinder having an air-inlet and valve, and a piston which moves forward while said inlet is open and rearward after it is closed for compressing the admitted air, of a spray-pipe arranged within the cylinder, an oil-receiving chamber communicating with said spray-pipe, an oil-pump which feeds oil to said chamber, a conduit through which compressed air is supplied to said chamber, and a valve which is opened for permitting the compressed air to drive the oil from said chamber through the spray-pipe into the cylinder, substantially as set forth.

3. The combination, with the engine-cylinder, its piston, and an air-inlet and valve which is opened during the forward stroke of the piston for admitting the air and closed during the return-stroke for compressing the air, of a burner arranged within the cylinder, an oil-receiving chamber provided with a discharge-valve and with a spray-pipe terminating near the burner, an air-compressor communicating with said chamber, an oil-pump connected with said chamber, and an automatic regulator whereby variable charges of oil are fed to said chamber, substantially as set forth.

4. The combination, with the engine-cylinder, its piston, and an air-inlet and valve, of a burner arranged within the cylinder, a chamber having a spray-pipe terminating near the burner, an oil-pump and an air-pump feeding oil and compressed air to said chamber, and a valve whereby the discharge of oil from said chamber is controlled, substantially as set forth.

5. The combination, with the engine-cylinder, its piston, and the air-inlet and valve, which is open during the forward stroke of the piston for admitting the air and closed during the return-stroke for compressing the air, of a burner arranged within the combustion-chamber of the cylinder, a receiving-chamber provided with a spray-nozzle within the combustion-chamber, and oil and air conduits through which oil and air are supplied to said chamber, substantially as set forth.